



## RESEARCH ARTICLE

### PREDICTIVE FACTORS FOR ANASTOMOTIC LEAKAGE IN LAPAROSCOPIC COLORECTAL SURGERY

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#### ABSTRACT

**Background:** Anastomotic leakage is one of the most feared complications of gastrointestinal surgery following any gastrointestinal anastomosis with overall impact on functional and oncologic outcome and drainage on hospital resources. It causes considerable morbidity and mortality. It is a serious complication following restorative resection for colorectal cancer (CRC) and contributes to local tumor recurrence. As the improvement in safety of oncological surgeries has increased, the anastomotic leakage still remains the most feared and devastating complication in both the surgical and oncological views, respectively. Anastomotic leakage also affects the outcome of surgery, increases the hospitalization expenses and worsens the prognosis. **Objectives:** To identify pre-operative, intra-operative and post-operative predictive factors for anastomotic leak in patients undergoing colorectal resection by way of the laparoscopic approach. **Study Design:** It was a prospective-observational study of 18 months (one and a half year) conducted in the Department of General Surgery, GMC, Srinagar. **Participants:** A total of 35 cases of laparoscopic colorectal surgeries operated by a single well-experienced laparoscopic surgeon from a single surgical unit (>18 years of age) were included while patients ≤18 years and patients undergoing open colorectal procedures were excluded. **Methodology:** After admission detailed history and clinical examination of the patient was done. Patient's data including gender, age, clinical presentation, tumor location and histopathological type and grade of tumor was noted. Pre-operative investigations concentrating on hematological and biochemical parameters, radiological imaging was done in each patient. **Results:** Out of 35 patients 2 (5.71%) patients had anastomotic leakage. In regard with the procedure done, anastomotic leakage occurred in 1 (5.6%) patient with right hemicolectomy and 1 (14.3%) patients with low anterior resection. Considering the type of anastomosis, both end-to-end and side-to-side anastomosis showed equal distribution in anastomotic leakage. Both the patients of anastomotic leakage had malignant disease. **Conclusion:** In our study, we had 2 patients out of 35 with anastomotic leakage. We observed higher age group, both male and female genders, type and site of anastomosis, level of anastomosis, size of tumor (≤2 cm above anal verge), intraoperative blood loss and underlying comorbidities such as vascular disease are the most prevalent risk factors for anastomotic leakage. **Implications:** Ours was an Observational Study. After observing the predictive factors for anastomotic leakage we recommend the thorough work-up of patients to note all the risk factors that can complicate the post-operative period of patients undergoing laparoscopic colorectal surgery for the better outcome.

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## INTRODUCTION

Intestinal anastomosis is a surgical procedure performed to establish communication between two formerly distant portions of the intestine. This procedure restores intestinal continuity after removal of a pathologic condition affecting the bowel. Intestinal anastomosis is one of the most commonly performed surgical procedures, especially in the emergency setting, and it is also commonly performed in the elective setting when resections are carried out for benign or malignant

lesions of the gastrointestinal (GI) tract. A disastrous complication of intestinal anastomosis is anastomotic leakage resulting in peritonitis, which is associated with high morbidity and mortality. Proper surgical technique and adherence to fundamental principles are imperative to ensure a successful outcome after intestinal anastomosis. Anastomotic leakage is one of the most feared complications of gastrointestinal surgery following any gastrointestinal anastomosis with overall impact on functional and oncologic outcome and drainage on hospital resources. It causes considerable

morbidity and mortality (1). It is a serious complication following restorative resection for colorectal cancer (CRC) and contributes to local recurrence. As the improvement in safety of oncological surgeries has increased, the anastomotic leakage still remains the most feared and devastating complication in both the surgical and oncological views, respectively. Anastomotic leakage also affects the outcome of surgery, increases the hospitalization expenses and worsens the prognosis (1). Anastomotic Leakage has a wide range of presentation, ranging from radiological only finding to peritonitis and sepsis with multi-organ failure. It may present as generalized peritonitis requiring abdominal reoperation, as a more localized collection that may discharge, or as a subclinical leak detected merely on contrast radiology. Hitherto those without peritonitis have been generally considered to be of less consequence. Quality of life is often affected due to poor functional outcomes with high rates of permanent stoma formation. Its reported incidence ranges from 1% to 30% (2). It has been found that the colorectal leaks variably depend on the anatomic location of the anastomosis, where documented literature reports its incidence rates ranging from 0 to 20%, while the laparoscopic approach to colorectal resections have not been found to be associated with significant reduction in AL incidence.

However, there are only few reports from our region, thus we aimed to study and evaluate the patients, who underwent colorectal resection by way of laparoscopic approach, to identify pre-operative, peri-operative and postoperative predictive factors for anastomotic leak in patients undergoing colorectal resection by way of the laparoscopic approach.

## MATERIALS AND METHODS

The present study was done in the Department of General Surgery at Government Medical College, Srinagar, Jammu and Kashmir. This was a Prospective observational study conducted over the period of 18 months. The Institutional Ethics Committee consent was obtained before collecting the data. Written and informed consent were taken from all patients enrolled into the study.

### Inclusion Criteria:

- Both male and female patients above 18 years of age.
- Patients who underwent colonicorectal surgery by laparoscopic path way for benign or malignant disease.
- Laparoscopic colorectal surgery procedures done by single surgeon.

### Exclusion Criteria

- Patients below 18 years of age.
- Patients undergoing open colorectal procedures.

All the patients who met inclusion criteria were enrolled for the study. After admission detailed history and clinical examination of the patient was done. Patient's data including gender, age, clinical presentation, tumor location and histopathological type and grade of tumor was noted. Pre-operative investigations concentrating on hematological and biochemical parameters, radiological imaging was done in each patient. The present study was intended to report the anastomotic leakage in patients operated by a single well-

experienced laparoscopic surgeon from a single surgical unit at our teaching hospital. All the data was summarized and entered in Microsoft excel sheet and then transferred to statistical software for analysis. Categorical variables were described as frequencies and percentages while as continuous variables as mean and standard deviation. Qualitative data was presented as frequency and percentages and analysed using Chi-square and Z-test was used for association between the categorical variables and a P value <0.05 was taken as statistically significant. We used Statistical Package for Social Sciences (SPSS Inc., version 16, Chicago, US), for statistical analysis.



**Image 1. Sigmoid Colon Circumferential enhancing stenotic thickening (green arrow) (Coronal Plane)**



**Image 2. Port Placement for right Hemicolectomy**

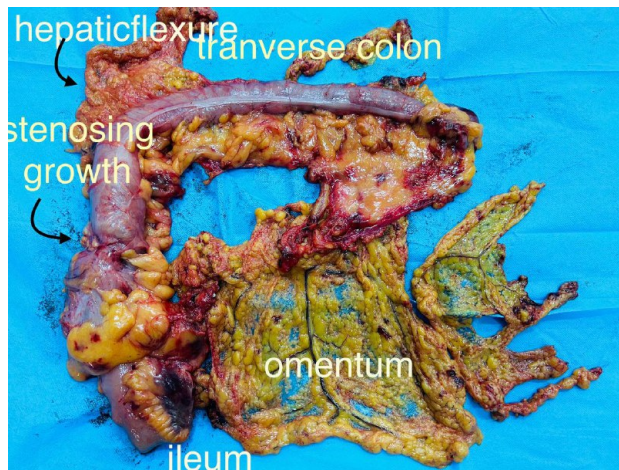


Image 3. Specimen of Lap D3 Right Hemicolectomy for Hepatic Flexure Growth



Image 4. Specimen of Total Colectomy (Laparoscopic)

## RESULTS

In our study a total of 35 patients underwent laparoscopic colorectal surgeries with the mean age of 42 years. The maximum number of patients were seen in the age group of 61-80 (48.6%) followed by 41-60 years (22.9%) [Table 1]. Out of 35 patients, 65.7% (n=23) were males and 34.3% (n=12) were females [Table 2]. 33 (94.3%) patients had malignant disease and 2 (5.7%) had benign disease [Table 3].

Table 1. Age Distribution

Age in years	Frequency (n)	Percentage (%)
21-40	6	17.1
41-60	8	22.9
61-80	17	48.6
>80	4	11.4
MEAN $\pm$ SD	42 $\pm$ 3.74	
Total	35	100.0

Table 2. Gender Distribution

Gender	Frequency (n)	Percentage (%)
Male	23	65.7
Female	12	34.3
Total	35	100.0

Table 3. Nature of Disease Distribution

Nature of Disease	Frequency (n)	Percentage (%)
Benign	2	5.7
Malignant	33	94.3
Total	35	100

The most common involved part of large gut was ascending colon 51.4% (n=18) (including Caecum and Hepatic flexure) followed by rectosigmoid 20% (n=7) (rectum and Sigmoid). Descending colon was involved in 14.3% (n=5) and transverse colon in 5.7% (n=2) of patients. One patient (2.9%) had FAP. Among benign conditions, inflammatory bowel disease and mid colic stricture accounted equally for 2.9% (n=1) [Table 4]. All 33 malignant disease were adenocarcinoma on histopathology with Grade 2 being most common in 11 (31.4%) patients followed by Grade 1 in 9 (25.7%) of patients. 7 (20%) patients had tumor of histological Grade 3. 5 (14.3%) patients had poorly differentiated carcinoma with signet ring cells on histopathology [Table 5].

Table 4. Part of involved gut

Tumor Location		Frequency (n)	Percentage (%)
Ascending colon		18	51.4
Transverse colon		2	5.7
Descending colon		5	14.3
Rectosigmoid		7	20
FAP		1	2.9
Benign	IBD	1	2.9
	Mid-colic Stricture	1	2.9
Total		35	100

Table 5. HPE Type Distribution

WHO Tumor Grade	Frequency (n)	Percentage (%)
Grade 3	7	20
Grade 2	11	31.4
Grade 1	9	25.7
Grade X with signet ring cells	5	14.3
FAP	1	2.9
Benign	2	5.7
Total	35	100.0

The most common procedure done was right hemicolectomy 52.4% (n=18) followed by low anterior resection and left hemicolectomy accounted for 20% (n=7) each. 2 (5.7%) patients underwent total hemicolectomy and one (2.9%) had transverse colectomy [Table 6]. The most common anastomosis done was side to side 77% (n=27) and remaining 23% (n=8) had end to end anastomosis [Table 7].

Table 6. Distribution by Procedure

Procedure	Frequency (n)	Percentage (%)
Right Hemicolectomy	18	51.4
Lower Anterior Resection	7	20
Left Hemicolectomy	7	20
Transverse Colectomy	1	2.9
Total Colectomy	2	5.7
Total	35	100

**Table 7. Anastomosis Type Distribution**

Anastomosis Type	Frequency (n)	Percentage (%)
Side-to-Side	27	77.1
End-to-End	8	22.9
Total	35	100

Out of 35 patients 2 (5.71%) patients had anastomotic leakage. In regard with the procedure done, anastomotic leakage occurred in 1 (5.6%) patient with right hemicolectomy and 1 (14.3%) patients with low anterior resection. Considering the type of anastomosis, both end-to-end and side-to-side anastomosis showed equal distribution in anastomotic leakage. Both the patients of anastomotic leakage had malignant disease.

**Table 8. Anastomotic Leakage and Procedure Type**

	Right Hemicolectomy		Left Hemicolectomy		Transverse Colectomy		Low Anterior Resection		Total Colectomy	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Patients with AL	1	5.6	0	0	0	0	1	14.3	0	0
Patients with no AL	17	94.4	5	100	1	100	6	85.7	2	100
Total	18		7		1		7		2	

**Table 9. AL and Nature of Disease**

	Benign		Malignant	
	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)
Patients with AL	0	0	2	6.1
Patients with no AL	2	100	31	93.9
Total	2		33	

**Table 10. Anastomotic Leakage and Anastomotic Type**

	Side-to-Side		End-to-End	
	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)
Patients with Anastomotic Leakage	1	3.7	1	12.5
Patients with no Anastomotic Leakage	26	96.3	7	87.5
Total	27		8	

**Table 11. Anastomotic Leakage and Pre-operative Predictive Factor**

Variables		Without AL	With AL	P value
Age of Patients		59.03 ±14.18	77.5 ±7.5	0.220
Gender	Male	22	1	0.629
	Female	11	1	
BMI		26.12 ±3.22	26.5 ±3.5	0.872
Co-morbidity		0.39±0.78 (0-3)	3±1.41 (2-4)	0.226
Albumin		3.73 ±0.44	3.35 ±0.35	0.241
Neoadjuvant		2	1	0.015
Size of Tumor		4.69 ±1.74	8 ±3	0.01

**Table 12. Anastomotic Leakage and Intra-operative Predictive Factors**

Factors	Patients with Anastomotic Leakage (n=2)	Patients with no Anastomotic Leakage (n=33)	P value
Level of anastomosis in LAR (cm)	5	2	0.500
Blood loss (ml)	122.06 ±49.62	275.00 ±25	<0.001
No of stapler firings	3.00 ±0	3.00 ±0	0
Level of anastomosis in LAR (cm)	5	2	0.500
Duration of surgery (in minutes)	217	240	0.221
Conversion	0	0	-

**Table 13. Anastomotic Leakage and Post-operative Predictive Factors**

Factors	Without AL	With AL	P value
Albumin	3.17±0.48	2.55 ±0.35	0.214
Wound Infection	0	0	-
Diarrhea	0	0	-
Mortality	2	0	-

## DISCUSSION

The rate of anastomotic leakage varies from 6 to 30% depending on different risk factors. Failure of colorectal anastomoses can have dire consequences, both acute and long-term, including longer lengths of stay, more interventions, and increased morbidity and mortality.

In our study, out of 35 patients, AL leak was occurred in two patients with equal gender distribution of one male (50%) and one female (50%). There was no statistical significance in terms of gender. In contrast to the other studies where large number of patients were analysed male gender was observed a risk factor for AL. Same findings were reported by Brisinda G *et al*(3) who in their study did not find gender as a significant predictive factor for AL. In contrast to the studies from; Kim *et al*(4), Tanaka K *et al*(5) and Park J *et al*(6), reported male gender as a significant risk factor for AL in their respective studies. In our study, the mean BMI in patients with AL and without AL were 26.5 ±3.5 and 26.12 ±3.22 kg/cm<sup>2</sup>. No significant difference was seen in terms of BMI in our study. In contrast, two studies have shown BMI as an independent risk factor for AL reported by Yamamoto S *et al*(7) and Silva-Velazco J *et al*. (8).

In our study, patients with AL had more underlying comorbidities than non-AL group, however the difference was not statistically significant. Vascular anomaly in one patient and underlying coronary artery disease in one patient were the main predictive factors of anastomotic leak and death of the patients. In our study, the mean pre-op serum albumin in patients with AL was 3.35 ±0.35 and without AL was 3.73 ±0.44. There was no significant difference seen between two groups in terms of pre-operative serum albumin. In our study, only 3 patients had received NACT, of these 2 were from non-AL group and 1 patient was from AL group. There was no significant difference seen between two groups in terms of Preoperative NACT. In contrast, several RC trials have observed preoperative chemoradiation as a risk factor for AL in a multivariate analysis as reported by Park J *et al* (6) and Hamabe A *et al* (9). In our study, the mean size of tumor in AL group was 8 ±3 cm and in non-AL group was 4.69±1.74 cm. the difference between the two groups in terms of tumor size was statistically highly significant (P=0.01). The findings were in favour of the observations from Zhu Q *et al* (10), Kawada K *et al* (11) who has reported large tumor size and higher TNM staging as the independent risk factor for AL.

In our study, patients with AL had anastomosis at 2 cm above the anal verge while as patients without anastomotic leak had at level of 5cm. the difference was found statistically significant. In our study, the mean intra-operative blood loss in AL group was 275.00 ±25 ml and in non-AL group was 122.06 ±49.62 ml. The difference was statistically highly significant (P<0.001). Allaix M *et al* (12) who reported intraoperative blood loss increase the conversion rates and AL. In our study, both groups had similar number of stapler findings with mean 3.00. No difference was seen in terms of stapler firings. Several studies have reported that 3 or more than 3 stapler firings during rectal division significantly increased the risk of AL after the laparoscopic double stapling technique, as reported by Ito M *et al* (13) and Park J *et al* (6). In our study, AL group had slightly longer duration of surgery with mean time of 240 minutes than non-AL group (mean time 217 minutes), however there was no significant difference. Silva-Velazco J *et al* (8) reported significant correlation between longer duration of operative time and AL. Kawada K *et al* (11) have shown that prolonged operative can be associated with AL.

There were no conversion cases in our study. In our study, AL group had hypoalbuminemia in post-operative period with mean serum albumin of 2.55 ±0.35 than non-AL group with mean serum albumin of 3.17±0.48. However, the difference was not statistically significant. None of the patient experienced wound infection in our study. None of the patient experienced post-operative diarrhea in our study.

## CONCLUSION

Anastomotic Leakage (AL) is the most dreadful complication in colorectal surgeries. AL increases the morbidity and mortality and hinders both physical and psychological health. From our study, we had 2 patients out of 35 with anastomotic leakage. We observed higher age group, both male and female genders, type and site of anastomosis, level of anastomosis, size of tumor, intraoperative blood loss, post-operative serum albumin levels and underlying comorbidities as the most prevalent risk factors for anastomotic leakage.

**Limitations:** Our study had certain limitations that included a small sample size and a shorter duration of the study period. We recommend further large group study for large duration to accede the observation we observed from our study.

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